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LUMBER RECOVERY FROM LARGE, HIGHLY DEFECTIVE, LOW GRADE COAST DOUGLAS-FIR

Thomas A. Snellgrove
John W. Henley
Marlin E. Plank

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Reference Abstract

Snellgrove, Thomas A., John W. Henley, and
Marlin E. Plank

1975. Lumber recovery from large, highly defective, low grade Coast Douglas-fir. USDA For. Serv. Res. Paper PNW-197, 23 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

A sample of 51 large diameter, highly defective, low grade Coast Douglas-fir trees were processed in a western Oregon sawmill. Lumber grade yields and recovery ratios are presented for two log-scaling and grading practices. The 51 trees generated 117 woods-length logs and 223 sawn-length logs which, in turn, produced about 1/4 million board feet of rough-green lumber. Some key results of this study are compared with an earlier study.

KEYWORDS: Lumber recovery studies, Coast Douglas-fir.

RESEARCH SUMMARY

Research Paper PNW-197

1975

Estimates of the lumber recovery that can be obtained from the full spectrum of Coast Douglas-fir are needed by forest-land managers, timber buyers, and timber processors for efficient utilization of the resource. Recovery information on Coast Douglas-fir sawtimber from typical commercial stands was presented in an earlier report (Lane et al. 1973). This report presents additional recovery information needed for large diameter, highly defective, low grade Coast Douglas-fir trees.

From a total of 51 sample trees, only No. 2 and No. 3 Sawmill grade logs were generated. The trees averaged about 61-inch d.b.h. and about 56-percent defect. They were processed through a western Oregon mill that normally handled material of this size and type.

General product recovery information is presented in table 1.

There was no significant relationship between percent of lumber recovery (overrun) and diameter, but there was a significant relationship between percent of lumber recovery and percent of estimated defect. Lumber recovery percent increased as defect percent increased, indicating that recovery percent was more closely related to estimated defect than to diameter.

A comparison of lumber grade yields from this study with the study conducted by Lane et al. showed differences that would be expected in view of the different samples. Lumber yields from this study contained 7.1 percent Selects versus 19.5 percent from the Lane et al. study. The percent of Utility and Economy was 74.1 for this study compared with 19.0 for the Lane et al. study.

TABLE 1.--Total log scale, lumber tally, and cubic volumes by log grade for Coast Douglas-fir sawtimber

Log grade	Number of logs	Log scale ^{1/}		Defect	Lumber tally		Cubic volume and recovery			
		Gross	Net		Volume	Recovery ratio ^{2/}	Log	Lumber recovery	Sawdust recovery	Residue recovery
- - <u>Board feet</u> - - <u>Percent</u> <u>Board feet</u> <u>Percent</u> <u>Cubic feet</u> - - - - - <u>Percent</u> - - - - -										
Sawn-length logs:										
No. 2 Sawmill	62	102,500	61,670	39.8	96,191	156	12,589	65	8	27
No. 3 Sawmill	161	175,130	114,250	34.8	167,390	147	22,982	61	8	31
Total or average	223	277,630	175,920	36.6	263,581	150	35,571	62	8	30
Woods-length logs:										
No. 2 Sawmill	36	102,400	53,800	47.5	109,293	203	15,153	61	8	31
No. 3 Sawmill	81	111,830	57,750	48.4	136,664	237	18,517	62	8	30
Total or average	117	214,230	111,550	47.9	245,957	220	33,670	62	8	30

^{1/} Sawn-length logs: as scaled by Bureau of Land Management check scaler by BLM rules, Scribner Decimal C log rule.
Woods-length logs: as scaled by Forest Service scaler by west-side rules, Scribner Decimal C log rule.

^{2/} Lumber tally volume as percentage of net scale volume.

Introduction

Coast Douglas-fir sawtimber,^{1/} one of the most important raw material resources in the United States, is found over a variety of environmental conditions in Washington, Oregon, and California. Stem quality, size, and defect vary greatly over the entire range of Coast Douglas-fir; thus, quality and value of its end products vary considerably. Because of this variability, correct valuation of this timber resource is very important. Estimates of the lumber recovery that can be obtained from the full spectrum of Douglas-fir are needed by forest-land managers, timber buyers, and timber processors for efficient utilization of the resource.

Information on recovery of lumber from Coast Douglas-fir has been reported by Lane et al. (1973). They presented recovery information for Douglas-fir trees selected from typical commercial sawtimber stands. However, additional recovery information was needed for atypical Douglas-fir sawtimber occurring in localized areas throughout its range; specifically, large diameter, highly defective, low grade Coast Douglas-fir trees.

The Pacific Northwest Forest and Range Experiment Station, Bureau of Land Management (U.S. Department of the Interior), Pacific Northwest Region (Region 6) of the National Forest System, and Hull-Oakes Lumber Company cooperated on this study. This report presents information on the grade and volume of various lumber items produced under current industry manufacturing practices from this highly defective portion of the resource in Oregon.

^{1/}Coast Douglas-fir refers to the botanical variety of Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco var. *menziesii*.

Study Procedures

TIMBER SAMPLE

The 51 study trees were selected from a timber sale in the Coast Ranges of Oregon. Logs cut from these trees were processed in a sawmill near Monroe, Oregon. The trees were representative of the large diameter, highly defective, low grade trees that occur within the Oregon range of Coast Douglas-fir. These trees were considered nonmerchantable when the stand was logged 30 to 40 years ago. Consequently, only grades No. 2 Sawmill and No. 3 Sawmill logs were produced. Some average characteristics of the trees selected were:

D. b. h.	Range	40 to 76 inches
	Average	61.3
Total height	Range	125 to 216 feet
	Average	171.2
Defect percent	Range	8.0 to 92.0
	Average	55.7

The objective was to obtain additional saw-log recovery information for a specific segment of the Coast Douglas-fir timber resource. The sample was not intended to be representative of the normal mix of Douglas-fir sawtimber that a mill would receive in a specified length of time.

LOGGING, IDENTIFICATION, SCALING, AND GRADING

The study trees were felled and bucked into logs by the cooperating logging contractor according to normal industry practice. Each log was numbered to identify its origin by tree and position in the tree.

The visible characteristics of each log were critically examined and recorded. Thus, the relationship of the external characteristics of a log to its yield by lumber

grade could be analyzed.

The study logs were trucked to the cooperating mill where they were graded and scaled in the lengths as delivered from the woods in accordance with practices used in the west-side Douglas-fir region.^{2/} The specifications are a modified version of the uniform Bureau rules,^{3/} for use in cruising standing trees where log end defects are not considered in determination of grade. The scale was also determined by Bureau rules (see footnote 3).

A Bureau of Land Management check scaler, applying the BLM rules,^{4/} rescaled and regraded the study logs after they were bucked for sawing. These scaling rules follow National Forest Log Scaling Handbook rules,^{5/} except for scale deduction procedures. In this scale, logs up to and including 20 feet in length are scaled as one segment, and diameters are rounded. Volumes are expressed in Scribner Decimal C rule in both scaling practices. For simplification in this report, the scale taken by the U.S. Forest Service check scaler will be called the "woods-length" scale, and the scale taken by the BLM check scaler will be called the "sawn-length" scale.

^{2/} U.S. Forest Service R-6 Supplement to National Forest Log Scaling Handbook for West-side Log Scaling. October 1965. U.S. Forest Service Log Grade Description for Douglas-fir. Form R-6 2440-19D, March 1965.

^{3/} Official Log Scaling and Grading Rules for the Columbia River Log Scaling and Grading Bureau, Puget Sound Log Scaling and Grading Bureau, Grays Harbor Log Scaling and Grading Bureau, Southern Oregon Log Scaling and Grading Bureau, Northern California Log Scaling and Grading Bureau. January 1, 1969.

^{4/} Bureau of Land Management Log Scaling Manual, May 1970.

^{5/} National Forest Log Scaling Handbook U.S. Department of Agriculture Forest Service Handbook 2409.11. Amended January 1969.

The 51 sample trees produced 117 merchantable woods-length logs and 223 merchantable sawn-length logs. Distribution of these logs by scaling diameter, length, and grade is shown in tables 2 and 3. As is apparent from table 2, logs to be processed were bucked to 28 feet or less.

SAWING, LUMBER GRADING, AND TALLYING

The logs were sawn under normal production conditions at the study sawmill. Equipment included a band headsaw, an edger, a vertical band resaw, and a gang trimmer.

The logs were sawn to obtain the highest value from each log following normal manufacturing procedures for producing board, dimension, and select items. The mill, however, did not produce any shop items, and their normal production of timbers was probably higher than most other Oregon sawmills manufacturing Douglas-fir.

Log identity was maintained on each piece of lumber throughout the manufacturing process to the final point of grading and tally. A West Coast Lumber Inspection Bureau grading inspector graded all study lumber on the green chain by West Coast Lumber Inspection Bureau (1970) rules for Douglas-fir. Each lumber item produced was placed into one of these grades:

B and Better Select	No. 1 or Construction
C Select	No. 2 or Standard
D Select	No. 3 or Utility
Select Structural	Economy

In subsequent tables, figures, and discussion, lumber grades No. 1, No. 2, and No. 3 include Construction, Standard, and Utility, respectively.

Each piece of lumber was tallied by its shipping dimensions, grade, and log number.

TABLE 2.--Number of woods-length and sawn-length Coast Douglas-fir logs by length and grade

Log length (feet)	Woods-length logs			Sawn-length logs		
	Grade		All grades	Grade		All grades
	No. 2 Sawmill	No. 3 Sawmill		No. 2 Sawmill	No. 3 Sawmill	
8	--	1	1	--	1	1
10	--	1	1	--	1	1
12	--	1	1	2	1	3
14	--	3	3	7	16	23
16	1	2	3	2	15	17
18	--	1	1	11	19	30
20	1	2	3	11	24	35
22	1	8	9	18	42	60
24	--	1	1	4	14	18
26	--	3	3	5	15	20
28	1	2	3	2	13	15
30	1	1	2	--	--	--
32	1	2	3	--	--	--
34	--	3	3	--	--	--
36	--	1	1	--	--	--
38	--	2	2	--	--	--
40	21	32	53	--	--	--
42	--	2	2	--	--	--
44	7	4	11	--	--	--
46	--	1	1	--	--	--
48	2	6	8	--	--	--
50	--	--	--	--	--	--
52	--	1	1	--	--	--
54	--	--	--	--	--	--
56	--	1	1	--	--	--
Total	36	81	117	62	161	223

TABLE 3.--Number of woods-length and sawn-length Coast Douglas-fir logs by diameter and grade

Scaling diameter (inches)	Woods-length logs			Sawn-length logs		
	Grade		All grades	Grade		All grades
	No. 2 Sawmill	No. 3 Sawmill		No. 2 Sawmill	No. 3 Sawmill	
10	--	2	2	--	2	2
11	--	5	5	--	3	3
12	--	--	--	--	2	2
13	--	4	4	1	1	2
14	1	3	4	1	2	3
15	--	3	3	1	4	5
16	--	2	2	--	1	1
17	--	2	2	--	4	4
18	--	6	6	--	4	4
19	1	3	4	1	7	8
20	--	3	3	--	3	3
21	--	2	2	1	3	4
22	--	4	4	--	8	8
23	1	2	3	1	3	4
24	--	3	3	--	8	8
25	2	1	3	2	4	6
26	1	2	3	--	6	6
27	--	--	--	--	3	3
28	1	2	3	3	5	8
29	--	2	2	2	4	6
30	1	2	2	--	4	4
31	--	3	3	1	8	9
32	2	--	2	3	8	11
33	1	3	4	1	2	3
34	2	2	4	1	4	5
35	--	5	5	--	--	--
36	2	2	4	3	5	8
37	--	--	--	--	9	9
38	2	4	6	2	3	5
39	1	--	1	2	3	5
40	3	1	4	1	2	3
41	--	--	--	4	5	9
42	2	--	2	1	3	4
43	1	--	1	3	2	5
44	2	2	4	2	4	6
45	3	1	4	5	2	7
46	2	2	4	2	7	9
47	1	--	1	2	3	5
48	1	1	2	2	1	3
49	1	2	3	--	1	1
50	--	--	--	1	1	2
51	--	1	1	1	--	1
52	--	--	--	1	2	3
53	--	--	--	1	2	3
54	1	--	1	2	1	3
55	--	--	--	4	1	5
56	--	--	--	--	1	1
57	1	--	1	--	--	--
58	--	--	--	1	--	1
59	--	--	--	1	--	1
60	--	--	--	1	--	1
61	--	--	--	--	--	--
62	--	--	--	1	--	1
Total	36	81	117	62	161	223

The tally was made on the green chain; the grader pencil-ripped and trimmed when necessary. The anticipated surfaced tally was recorded.

COMPILATION OF DATA

In addition to lumber grade and board-foot volume data collected, cubic volumes of logs, lumber, residues, and sawdust were calculated for all study logs.

The gross cubic-foot log volume was computed by the formula:

$$V = 0.00181805 L(D_s^2 + D_s D_e + D_e^2)$$

where V = gross cubic-foot log volume

D_s = diameter in inches of small end of log

D_e = diameter in inches of large end of log

L = log length in feet

The lumber cubic volumes were based on average rough green dimensions of the various lumber sizes. The average dimensions were obtained by measuring samples of all lumber items produced throughout the study.

Sawdust cubic volumes were calculated by using an average saw kerf of 0.25 inch and the computed surface area of the rough green lumber from each log. Cubic volume of residue was obtained by subtracting the lumber and sawdust volumes from the gross cubic volume of woods-length logs. Thus, the residue volume included a small amount of sawdust from the production of slabs, edgings, and trim ends. Note that the gross cubic volume is based on scale lengths, so an average trim allowance of 6 inches would increase the gross cubic volume of the average log by about 2.4 percent, and there would be a corresponding increase in the volume of residue.

The lumber grade yield from the woods-length logs was obtained by combining the lumber recovery from the sections sawn from each woods-length log.

Results and Discussion

Table 4 summarizes the total log scale, lumber tally, and cubic volume of the logs in the study for each log grade and for all grades combined. A more detailed breakdown of these data, including lumber grade yields by scaling diameter and log grade, is presented in tables 8 through 17 in the

TABLE 4.--Total log scale, lumber tally, and cubic volumes for Coast Douglas-fir by log grade

Log grade	Number of logs	Log scale ^{1/}		Defect	Lumber tally		Cubic volume				
		Gross	Net		Volume	Recovery ratio ^{2/}	Log	Lumber	Lumber recovery ratio ^{3/}	Sawdust	Residue
		- - Board feet - -			Percent	Board feet	Percent	- - Cubic feet - -		Percent	- - Cubic feet - -
Sawn-length logs:											
No. 2 Sawmill	62	102,500	61,670	40	96,191	156	12,589	8,128	65	1,071	3,390
No. 3 Sawmill	161	175,130	114,250	35	167,390	147	22,982	14,091	61	1,780	7,111
Total or average	223	277,630	175,920	37	263,581	150	35,571	22,218	62	2,851	10,502
Woods-length logs:											
No. 2 Sawmill	36	102,400	53,800	48	109,293	203	15,154	9,206	61	1,216	4,732
No. 3 Sawmill	81	111,830	57,750	48	136,664	237	18,517	11,517	62	1,430	5,570
Total or average	117	214,230	111,550	48	245,957	220	33,670	20,723	62	2,646	10,301

^{1/} Sawn-length logs: as scaled by Bureau of Land Management scaler by 8LM rules, Scribner Decimal C log rule.
Woods-length logs: as scaled by Forest Service scaler by west-side log scaling rules, Scribner Decimal C log rule.

^{2/} Lumber tally volume as percentage of net scale volume.

^{3/} Lumber cubic volume as percentage of log cubic volume.

appendix. Data considered of value to the reader are presented for both sawn-length and woods-length logs. In general, only sawn-length log data are discussed.

DEFECT

The relationship of scale defect to scaling diameter for both sawn-length and woods-length logs is shown in figure 1.

for woods-length logs is substantially higher than for sawn-length logs, i.e., 47.9 compared with 36.9, probably because the more defective portions of the woods-length logs were culled as they were bucked to sawn-lengths. For the sawn-length logs, there was also a slight difference in percent of defect between log grades, as shown in table 4. The No. 2 Sawmill logs on the average were 5 percent more defective than the No. 3 Sawmill logs.

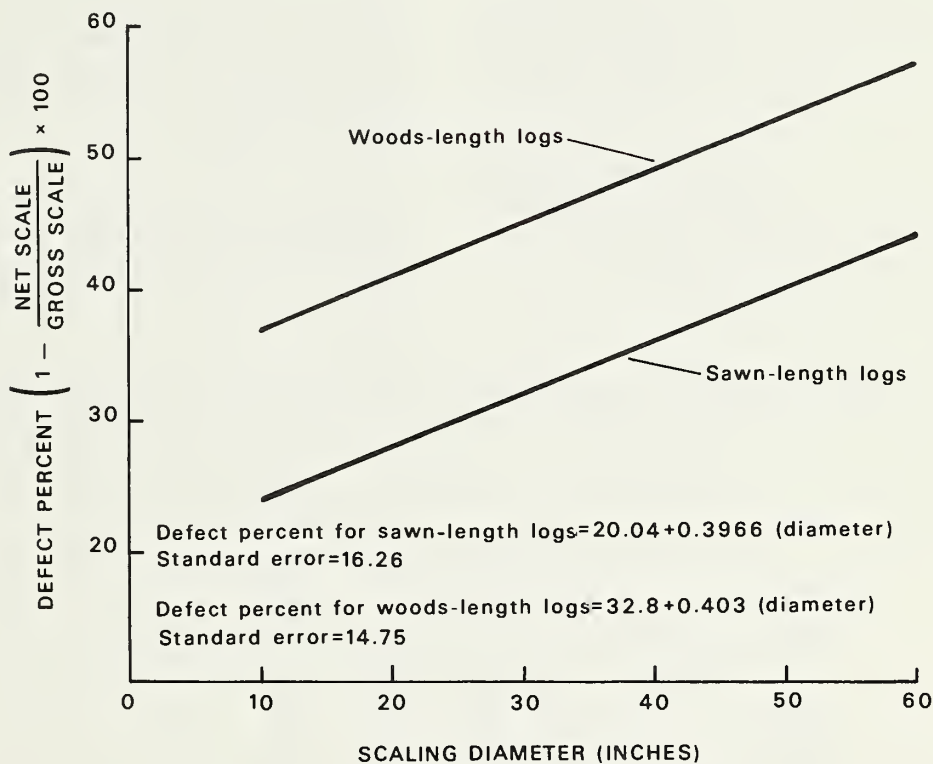


Figure 1.--Relationship of scale defect to scaling diameter.

As would be expected, percent of defect increased with an increase in scaling diameter for both sawn-length and woods-length logs. The average percent of defect

These differences in defect probably account for some of the differences in lumber yields that will be shown later.

LUMBER RECOVERY

As shown in table 4, the 223 sawn-length logs produced 263,581 board feet of lumber, and the 117 woods-length logs produced 245,957 board feet. The difference between the lumber tally volume produced from the sawn-length and the woods-length logs is due to more woods-length logs being scaled as cull (defect greater than 66-2/3 percent).

The distribution in percent of lumber volume of the sawn-length logs is summarized by grade, thickness, and width in table 5. Approximately 63 percent of the production was in 2-inch dimension items, 21 percent in 5-inch and thicker items, about 15 percent in 3-inch material, and the remaining 1 percent in 1-inch boards. The thickness, width, and grade distribution of the lumber volume in the woods-length logs are, for all practical purposes, the same as for sawn-length logs.

LUMBER GRADE YIELDS

Yields by lumber grades, expressed as a percent of lumber tally volume by log grade for sawn-length and woods-length logs, are shown in table 6. Eight lumber items were produced. For all sawn-length logs, approximately 74 percent of the lumber produced was in No. 3 and Economy grades, indicating both high defect and poor quality of the study logs. Table 6 also shows that, for sawn-length No. 2 Sawmill logs, about 15 percent of the lumber volume was in Selects compared with less than 3 percent for the No. 3 Sawmill logs. No. 2 Sawmill logs produced a lower percentage of No. 3 and Economy grade lumber than the No. 3 Sawmill logs; i. e., 68 percent compared with 77 percent.

Lumber grade yields, expressed as a percent of the lumber tally volume by scaling diameter for individual log grades, are shown

TABLE 5.--Distribution of lumber volume by grade, thickness, and width from Coast Douglas-fir sawn-length logs

Thickness	Width	Volume	Grade								
			B and Better Select	C Select	O Select	Select Structural	No. 1 and Construction	No. 2 and Standard	No. 3 and Utility	Economy	All
-- Inches --		Board feet	Percent of total lumber volume								
1	3.4	719	0	0.08	0.01	0.01	0.01	0.02	0.07	0.06	0.26
	6	780	0	.07	.01	.01	.05	.03	.07	.06	.30
	8	1,187	0	.06	0	0	.07	.08	.15	.08	.44
	10	55	0	0	0	0	.01	0	0	.01	.02
	12	40	0	0	0	0	0	0	0	.02	.02
Total		2,781	0	.21	.02	.02	.14	.13	.29	.23	1.04
2	3.4	8,835	0	.60	.11	.04	.13	.15	.80	1.52	3.35
	6	11,201	0	.70	.22	.15	.23	.32	.97	1.66	4.25
	8	52,207	.04	1.36	.38	.35	1.01	1.98	5.49	9.19	19.80
	10	43,372	0	.51	.06	.31	.80	1.84	6.20	6.75	16.47
	12	49,835	0	.22	.07	.56	1.06	2.42	8.25	6.32	18.90
Total		165,450	.04	3.39	.84	1.41	3.23	6.71	21.71	25.44	62.77
3	4	1,899	0	.12	.02	0	.04	.04	.18	.32	.72
	6	6,187	0	1.07	.13	.06	.19	.13	.44	.33	2.34
	8	4,102	0	1.03	.03	.02	.06	.10	.19	.13	1.56
	10	6,356	0	.15	0	.03	.05	.05	.68	1.44	2.41
	12	20,214	0	.06	.02	.15	.46	.89	2.84	3.25	7.67
Total		38,758	0	2.43	.20	.26	.80	1.21	4.33	5.47	14.70
≥ 5	8	21,126	0	0	0	0	.02	.04	1.30	6.65	8.01
	10	26,826	0	.02	.02	0	.31	2.68	5.34	1.82	10.18
	12	8,640	0	0	0	0	.05	1.73	1.40	.09	3.28
Total		56,592	0	.02	.02	0	.38	4.45	8.04	8.56	21.47
Total, all items		263,581	.04	6.05	1.08	1.69	4.55	12.50	34.37	39.70	1/99.98

^{1/} The percentages may not add to an even 100 percent because of rounding.

TABLE 6.--Average yields from Coast Douglas-fir by lumber grade expressed as a percent of lumber tally volume and by log grade

Log grade	Number of logs	Lumber tally volume	Lumber grade							
			B and Better Select	C Select	D Select	Select Structural	No. 1 and Construction	No. 2 and Standard	No. 3 and Utility	Economy
Board feet										
Sawn-length logs:										
No. 2 Sawmill	62	96,191	0.04	12.38	2.25	3.08	5.33	8.61	27.64	40.67
No. 3 Sawmill	161	167,390	.05	2.38	.39	.91	4.11	14.74	38.28	39.14
Total or average	223	263,581	.04	6.03	1.07	1.70	4.55	12.51	34.40	39.70
Woods-length logs:										
No. 2 Sawmill	36	109,293	.02	9.91	1.68	2.42	4.98	10.25	27.81	42.93
No. 3 Sawmill	81	136,664	.03	2.35	.39	.85	4.10	14.03	39.95	38.30
Total or average	117	245,957	.02	5.71	.97	1.54	4.49	12.35	34.56	40.36

in tables 14-17 of the appendix. The same information is shown in curve form for sawn-length logs in figures 2 and 3. The variability that occurs in lumber yield has been smoothed by curving to indicate yield patterns. These curves show that there is a statistically significant increase in the percentage of Selects with an increase in scaling diameter for No. 3 Sawmill logs, but not for No. 2 Sawmill logs. For both No. 2 and No. 3 Sawmill logs, the percentage of Economy lumber increased as the scaling diameter increased at the expense of the percentage of Select Structural, No. 1,

and No. 2 lumber. The data also indicate no significant relationship between scaling diameter and the percentage of Utility grade lumber for either log grade.

LUMBER RECOVERY PERCENT (OVERRUN)

For the sawn-length logs, there was no statistically significant relationship between lumber recovery percent (overrun) and diameter by individual log grade nor for both grades combined. The net scale for the sawn-length logs in the study was 175,920

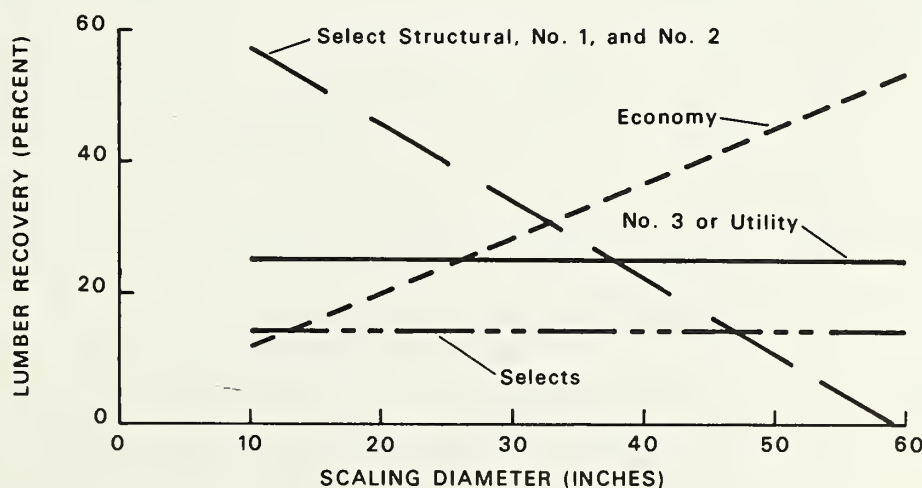


Figure 2.--Lumber grade recovery expressed as a percent of lumber volume over diameter for sawn-length No. 2 Sawmill logs.

board feet while 263,581 board feet of lumber was actually produced, thus giving a recovery of 150 percent (fig. 4). No. 2 Sawmill logs had an average recovery

of 156 percent compared with 147 percent for No. 3 Sawmill logs. However, this difference was not statistically significant.

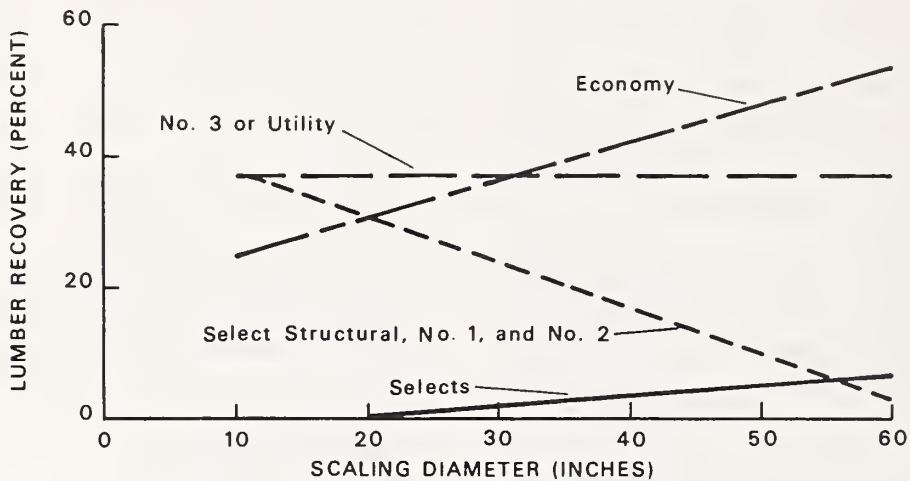


Figure 3.--Lumber recovery expressed as a percent of lumber tally volume over diameter for sawn-length No. 3 Sawmill logs.

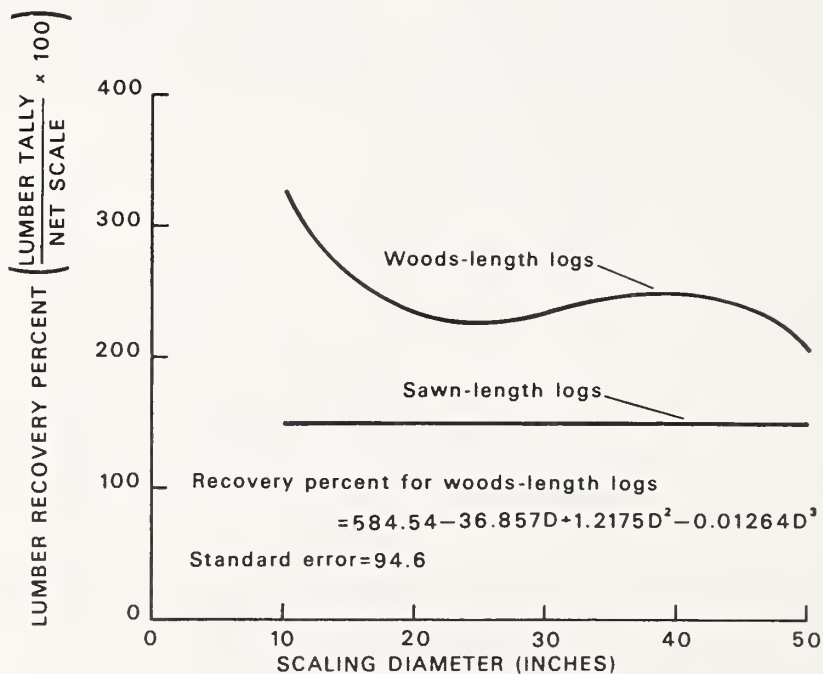


Figure 4.--Relationship of net log scale-lumber recovery percent to scaling diameter.

The reason for the lack of significance between recovery percent and diameter for sawn-length logs probably lies in the sample. As stated in the sampling section of this paper, the study logs represented a specific segment of the total population and were not intended to be representative of the total population. The study trees had a minimum d.b.h. of 40 inches, producing a disproportionate share of large, highly defective logs.

On the other hand, figure 5 shows a

significant relationship between recovery percent and defect percent. Recovery percent increased as defect percent increased, indicating that, at least for this sample, recovery percent was more closely related to estimated defect than to diameter. A stepwise multiple regression analysis substantiated this hypothesis. Recovery percent for woods-length logs is also shown in figure 4. Due to the different scale basis, the woods-length percents are consistently higher.

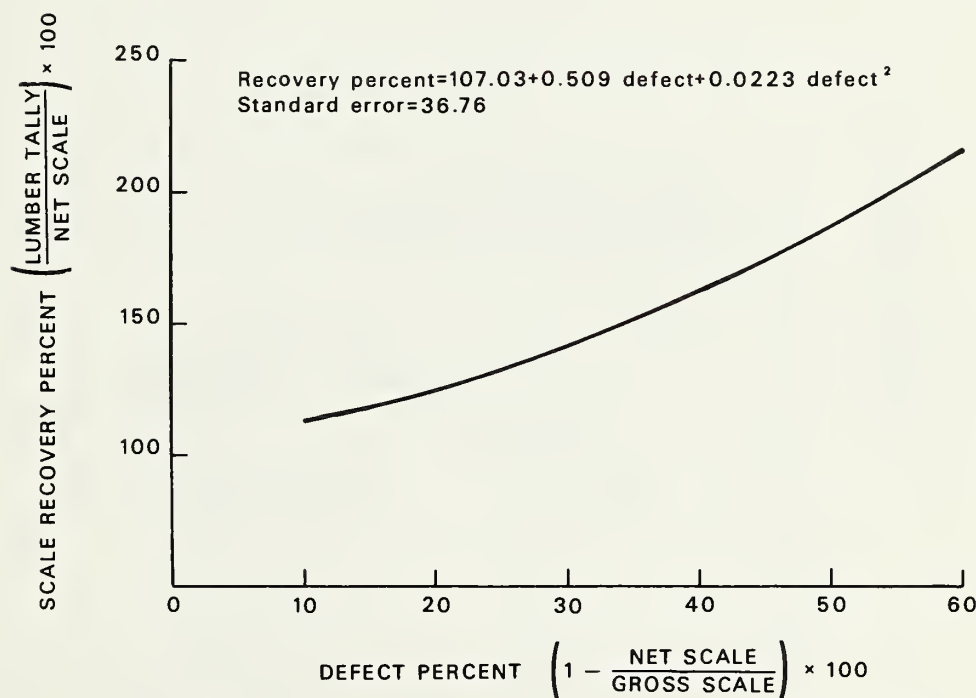


Figure 5.--Relationship of net log scale-lumber recovery percent to defect percent, sawn-length logs.

CUBIC RATIOS

The relationship of the lumber cubic volume recovery percent to scaling diameter is shown in figure 6. As would be expected, cubic recovery increases with an increase in diameter up to about 40 inches, then decreases. The reduction in cubic recovery at about 40 inches is probably due to the higher defect percentages in the larger diameter logs.

On the average, about 62.5 percent of the cubic content of the sawn-length logs was manufactured into rough green lumber, and about 8 percent of the volume was in sawdust. The remaining 29.5 percent of the cubic content of the logs could be considered mill residue, a substantial

proportion of which would be available for chipping.

Figure 7 shows the relationship of board feet of lumber produced per cubic foot of log input. As would be expected, the general shape of the curve is similar to the cubic recovery percent curve. For sawn-length logs, an average of 7.2 board feet of lumber was produced for every cubic foot of log input.

COMPARATIVE RESULTS

A few key results of this study will be compared with results from an earlier Coast Douglas-fir study (Lane et al. 1973). Results of these two studies are shown in table 7.

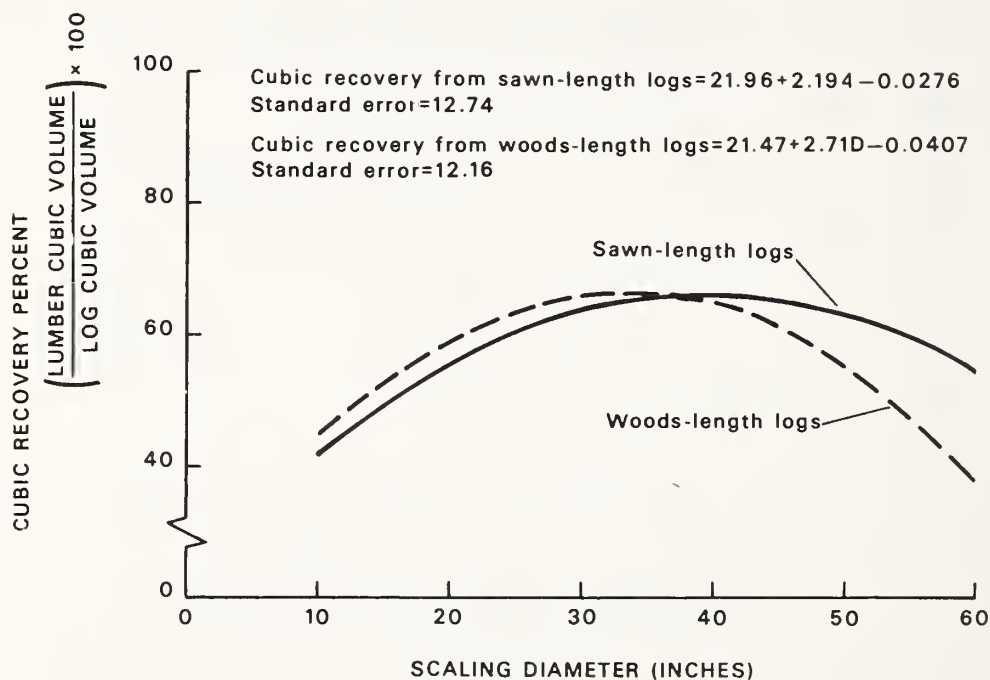


Figure 6.--Relationship of lumber cubic volume recovery percent to scaling diameter.

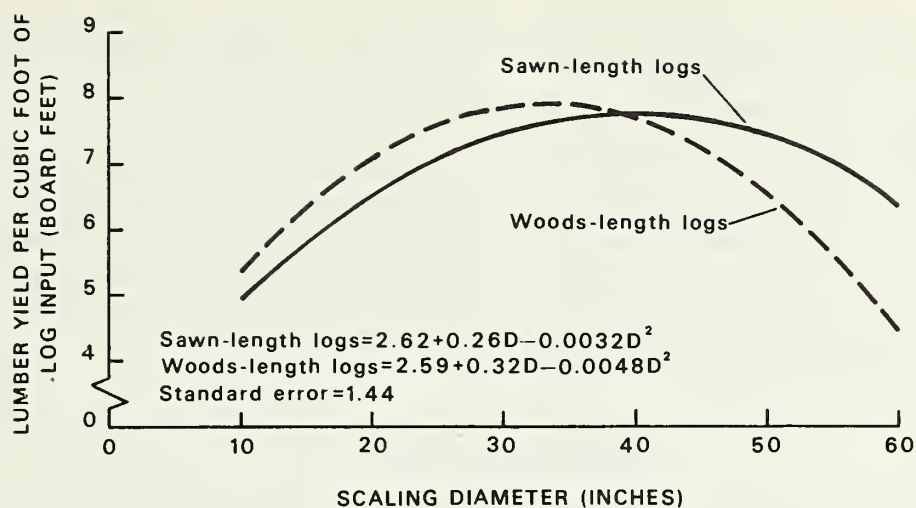


Figure 7.--Relationship of board-foot yield per cubic foot of log input to scaling diameter.

TABLE 7.--Comparison of some average results from two studies of lumber recovery from Coast Douglas-fir

Characteristic and study	Scaling condition	
	Sawn-length logs	Woods-length logs
Defect percent:		
Present ^{1/}	37.0	47.9
PNW-154 ^{2/}	13.0	14.5
Lumber recovery percent:		
Present	150.0	220.0
PNW-154	117.0	133.0
Cubic recovery percent:		
Present	62.0	62.0
PNW-154	64.0	63.0
Recovery factor (board feet per cubic foot): ^{3/}		
Present	7.4	7.3
PNW-154	7.4	7.4
Percent Selects:		
Present	7.1	6.7
PNW-154	19.5	19.5
Percent No. 3 and Economy:		
Present	74.1	74.9
PNW-154	19.0	18.8

^{1/} Study reported in this paper.

^{2/} USDA Forest Service Research Paper PNW-154 (Lane et al. 1973).

^{3/} Recovery factor = board feet of lumber yield per cubic foot of log input.

As shown in table 7, the cubic recovery percent and recovery factor for both studies are almost the same, but the percent of lumber yield by grade was noticeably different. Lumber yield from this study contained 7.1 percent Selects versus 19.5 percent reported in PNW-154 (Lane et al. 1973), and the percent No. 3 and Economy was 74.1 percent for this study versus 19.0 percent for PNW-154. These comparisons are more understandable when the difference in defect between the studies is noted

along with the log grade mix. This study had only No. 2 and No. 3 Sawmill logs, but 17 percent of the logs in PNW-154 were of a higher grade.

It is evident from the comparison of these two studies that the additional information was needed to describe the utilization potential of the low-grade, defective portion of the Douglas-fir timber resource.

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Appendix

Tables 8 - 17

TABLE 8.--Log scale, lumber tally, and cubic volume by scaling diameter for No. 2 Sawmill
sawn-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Log scale ^{1/}		Lumber tally		Cubic volume					
		Gross	Net	Volume	Recovery ratio ^{2/}	Log	Lumber	Lumber recovery ratio ^{3/}	Sawdust	Residue	
		- - - Board feet		- - - Percent		- - - Cubic feet		- - - Percent		- - - Cubic feet	
13	1	70	60	53	88	12.89	4.57	35	0.60	7.72	
14	1	140	130	173	133	26.45	14.48	55	2.54	9.43	
15	1	230	170	286	168	35.16	23.73	67	3.77	7.66	
16	0	--	--	--	--	--	--	--	--	--	
17	0	--	--	--	--	--	--	--	--	--	
18	0	--	--	--	--	--	--	--	--	--	
19	1	270	240	344	143	39.37	29.07	74	2.51	7.79	
20	0	--	--	--	--	--	--	--	--	--	
21	1	470	240	534	222	61.02	44.95	74	5.29	10.78	
22	0	--	--	--	--	--	--	--	--	--	
23	1	600	490	635	130	78.77	53.00	67	6.60	19.17	
24	0	--	--	--	--	--	--	--	--	--	
25	2	1,450	1,040	925	89	180.17	77.46	43	12.56	90.15	
26	0	--	--	--	--	--	--	--	--	--	
27	0	--	--	--	--	--	--	--	--	--	
28	3	2,760	2,170	2,564	118	339.89	214.45	63	30.55	94.89	
29	2	1,780	1,350	1,737	129	220.00	145.31	66	21.70	52.99	
30	0	--	--	--	--	--	--	--	--	--	
31	1	1,230	620	976	157	165.21	81.32	49	12.73	71.16	
32	3	2,330	1,630	2,681	164	305.38	225.06	74	32.53	47.79	
33	1	1,250	530	571	108	156.10	48.39	31	7.19	100.52	
34	1	1,160	1,000	1,328	133	147.11	111.70	76	14.51	20.90	
35	0	--	--	--	--	--	--	--	--	--	
36	3	4,240	2,840	4,127	145	531.87	347.41	65	41.45	143.01	
37	0	--	--	--	--	--	--	--	--	--	
38	2	3,110	1,720	3,373	196	394.44	283.08	72	40.34	71.02	
39	2	3,600	2,910	3,282	113	435.11	274.01	63	42.82	118.28	
40	1	900	400	882	220	110.09	75.59	69	9.63	24.87	
41	4	7,100	3,750	6,328	169	868.71	535.65	62	71.90	261.16	
42	1	1,510	1,050	1,396	133	185.99	119.06	64	15.92	51.01	
43	3	4,880	2,500	5,146	206	605.52	435.49	72	60.36	109.67	
44	2	3,780	2,400	3,788	158	447.58	319.62	71	48.78	79.18	
45	5	10,320	5,420	11,291	208	1,240.50	957.61	77	110.84	172.05	
46	2	2,780	1,710	2,537	148	337.50	215.38	64	31.01	91.11	
47	2	4,460	2,700	5,302	196	544.86	448.01	82	55.15	41.70	
48	2	4,100	2,300	3,886	169	513.91	330.00	64	46.91	137.00	
49	0	--	--	--	--	--	--	--	--	--	
50	1	2,110	1,190	1,158	97	260.60	96.76	37	15.43	148.41	
51	1	3,330	1,940	3,376	174	398.91	283.59	71	37.82	77.50	
52	1	2,280	1,220	1,113	91	275.87	93.56	34	14.41	167.90	
53	1	1,840	970	1,857	191	226.97	157.99	70	19.40	49.58	
54	2	5,190	2,310	5,028	218	627.88	429.03	68	51.43	147.42	
55	4	9,340	6,120	7,903	129	1,152.75	668.81	58	87.69	396.25	
56	0	--	--	--	--	--	--	--	--	--	
57	0	--	--	--	--	--	--	--	--	--	
58	1	3,150	1,740	2,003	115	386.43	168.38	44	25.81	192.24	
59	1	3,730	1,630	2,805	172	439.47	239.84	55	25.41	174.22	
60	1	3,790	3,150	4,132	131	446.61	350.36	78	30.62	65.63	
61	0	--	--	--	--	--	--	--	--	--	
62	1	3,250	2,030	2,671	132	389.75	225.06	58	34.40	130.29	
Total or average	62	102,500	61,670	96,191	156	12,588.84	8,127.78	65	1,070.61	3,390.45	

^{1/} As scaled by Bureau of Land Management scaler by east-side log scaling rules, Scribner Decimal C log rule.

^{2/} Lumber tally volume as percentage of net scale volume.

^{3/} Lumber cubic volume as percentage of log cubic volume.

TABLE 9.--Log scale, lumber tally, and cubic volume by scaling diameter for No. 3 Sawmill
sawn-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Log scale ^{1/}		Lumber tally		Cubic volume				
		Gross	Net	Volume	Recovery ratio ^{2/}	Log	Lumber	Lumber recovery ratio ^{3/}	Sawdust	Residue
		- - - Board feet - - -			Percent	- - Cubic feet - -		Percent	- - Cubic feet - -	
10	2	320	190	423	223	72.25	35.60	49	5.08	31.57
11	3	260	210	342	163	55.60	28.84	52	4.95	21.81
12	2	370	260	395	152	68.87	32.98	48	4.90	30.99
13	1	110	110	84	76	26.02	7.04	27	1.19	17.79
14	2	330	220	278	126	56.74	23.63	42	2.41	30.70
15	4	940	660	973	147	160.89	82.47	51	7.76	70.66
16	1	280	280	320	114	41.82	26.87	64	2.90	12.05
17	4	1,240	720	1,301	181	190.82	109.67	57	13.57	67.58
18	4	720	550	628	114	117.51	52.90	45	7.03	57.58
19	7	2,110	1,530	2,144	140	340.90	180.73	53	21.88	138.29
20	3	720	570	722	127	123.54	60.32	49	7.97	55.25
21	3	1,440	850	1,399	165	220.95	118.16	53	15.67	87.12
22	8	4,120	2,870	3,714	129	586.97	311.77	53	40.44	234.76
23	3	2,000	1,230	1,688	137	290.26	141.87	49	18.67	129.72
24	8	4,930	2,930	5,294	181	730.69	444.05	61	59.61	227.03
25	4	1,990	1,360	1,773	130	264.21	148.44	56	20.40	95.37
26	6	4,250	2,640	4,237	160	593.11	357.71	60	45.35	190.05
27	3	1,990	1,410	1,782	126	284.12	149.65	53	21.15	113.32
28	5	4,870	3,380	4,039	119	653.63	338.94	52	50.45	264.24
29	4	3,740	3,160	4,116	130	493.42	344.12	70	49.67	99.63
30	4	3,370	2,170	3,653	168	464.25	308.91	67	34.34	121.00
31	8	8,270	5,330	8,492	159	1,136.45	717.64	63	82.66	336.15
32	8	8,420	5,380	9,320	173	1,130.89	787.61	70	87.27	256.01
33	2	2,570	2,060	2,810	136	341.99	236.00	69	29.37	76.62
34	4	3,800	2,850	4,237	149	551.81	355.74	64	48.74	147.33
35	0	--	--	--	--	--	--	--	--	--
36	5	6,480	3,650	6,684	183	890.23	567.33	64	71.03	251.87
37	9	13,420	9,290	14,498	156	1,722.51	1,220.55	71	135.74	366.22
38	3	5,050	3,070	5,118	167	660.87	428.93	65	52.54	179.40
39	3	5,120	3,110	4,802	154	655.24	406.02	62	49.87	199.35
40	2	3,000	2,270	2,547	112	371.81	215.67	58	28.87	127.27
41	5	9,190	6,460	9,008	139	1,142.24	764.41	67	70.21	307.62
42	3	6,000	4,490	6,217	138	732.42	523.10	71	75.99	133.33
43	2	3,480	1,880	2,573	137	427.77	217.77	51	29.83	180.17
44	4	7,250	4,770	6,007	126	869.62	503.46	58	74.57	291.59
45	2	4,540	2,520	4,410	175	562.79	373.01	66	47.76	141.93
46	7	17,170	10,860	16,391	151	2,118.89	1,371.15	65	172.42	575.32
47	3	6,960	5,170	5,807	112	876.07	486.63	56	70.96	318.48
48	1	2,700	1,860	1,962	105	327.77	164.07	50	25.88	137.82
49	1	1,570	1,050	1,445	138	194.90	120.45	62	18.32	56.13
50	1	2,110	1,510	2,201	146	260.60	185.52	71	22.16	52.92
51	0	--	--	--	--	--	--	--	--	--
52	2	5,710	2,700	3,965	147	695.30	338.24	49	39.15	317.91
53	2	4,860	2,990	4,448	149	579.41	372.96	64	49.82	156.63
54	1	2,180	1,120	1,381	123	264.07	114.85	43	15.57	133.65
55	1	2,830	1,590	1,998	126	348.47	167.78	48	26.66	154.03
56	1	2,350	970	1,764	182	283.62	147.04	52	19.66	116.92
Total or average	161	175,130	114,250	167,390	147	22,982.22	14,090.60	61	1,780.44	7,111.18

^{1/} As scaled by Bureau of Land Management scaler by east-side log scaling rules, Scribner Decimal C log rule.

^{2/} Lumber tally volume as percentage of net scale volume.

^{3/} Lumber cubic volume as percentage of log cubic volume.

TABLE 10.--Log scale, lumber tally, and cubic volume by scaling diameter for all log grades of sawn-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Log scale ^{1/}		Lumber tally		Cubic volume					
		Gross	Net	Volume	Recovery ratio ^{2/}	Log	Lumber	Lumber recovery ratio ^{3/}	Sawdust	Residue	
		- - - - Board feet - - - -		- - - - Percent - - - -		- - Cubic feet - -		- - Percent - -		- - Cubic feet - -	
10	2	320	190	423	223	72.25	35.60	49		5.08	31.57
11	3	260	210	342	163	55.60	28.84	52		4.95	21.81
12	2	370	260	395	152	68.87	32.98	48		4.90	30.99
13	2	180	170	137	81	38.91	11.61	30		1.79	25.51
14	3	470	350	451	129	83.19	38.11	46		4.95	40.13
15	5	1,170	830	1,259	152	196.05	106.20	54		11.53	78.32
16	1	280	280	320	114	41.82	26.87	64		2.90	12.05
17	4	1,240	720	1,301	181	190.82	109.67	57		13.57	67.58
18	4	720	550	628	114	117.51	52.90	45		7.03	57.58
19	8	2,380	1,770	2,488	141	380.27	209.80	55		24.39	146.08
20	3	720	570	722	127	123.54	60.32	49		7.97	55.25
21	4	1,910	1,090	1,933	177	281.97	163.11	58		20.96	97.90
22	8	4,120	2,870	3,714	129	586.97	311.77	53		40.44	234.76
23	4	2,600	1,720	2,323	135	369.03	194.87	53		25.27	148.89
24	8	4,930	2,930	5,294	181	730.69	444.05	61		59.61	227.03
25	6	3,440	2,400	2,698	112	444.38	225.90	51		32.96	185.52
26	6	4,250	2,640	4,237	160	593.11	357.71	60		45.35	190.05
27	3	1,990	1,410	1,782	126	284.12	149.65	53		21.15	113.32
28	8	7,630	5,550	6,603	119	993.52	553.39	56		81.00	359.13
29	6	5,520	4,510	5,853	130	713.42	489.43	69		71.37	152.62
30	4	3,370	2,170	3,653	168	464.25	308.91	67		34.34	121.00
31	9	9,500	5,950	9,468	159	1,301.66	798.96	61		95.39	407.31
32	11	10,750	7,010	12,001	171	1,436.27	1,012.67	71		119.80	303.80
33	3	3,820	2,590	3,381	131	498.09	284.39	57		36.56	177.14
34	5	4,960	3,850	5,565	145	698.92	467.44	67		63.25	168.23
35	0	--	--	--	--	--	--	--		--	--
36	8	10,720	6,490	10,811	167	1,422.10	914.74	64		112.48	394.88
37	9	13,420	9,290	14,498	156	1,722.51	1,220.55	71		135.74	366.22
38	5	8,160	4,790	8,491	177	1,055.31	712.01	67		92.88	250.42
39	5	8,720	6,020	8,084	134	1,090.35	680.03	62		92.69	317.63
40	3	3,900	2,670	3,429	128	481.90	291.26	60		38.50	152.14
41	9	16,290	10,210	15,336	150	2,010.95	1,300.06	65		142.11	568.78
42	4	7,510	5,540	7,613	137	918.41	642.16	70		91.91	184.34
43	5	8,360	4,380	7,719	176	1,033.29	653.26	63		90.19	289.84
44	6	11,030	7,170	9,795	137	1,317.20	823.08	62		123.35	370.77
45	7	14,860	7,940	15,701	198	1,803.20	1,330.62	74		158.60	313.98
46	9	19,950	12,570	18,928	151	2,456.39	1,586.53	65		203.43	666.43
47	5	11,420	7,870	11,109	141	1,420.93	934.64	66		126.11	360.18
48	3	6,800	4,160	5,848	141	841.68	494.07	59		72.79	274.82
49	1	1,570	1,050	1,445	138	194.90	120.45	62		18.32	56.13
50	2	4,220	2,700	3,359	124	521.20	282.28	54		37.59	201.33
51	1	3,300	1,940	3,376	174	398.91	283.59	71		37.82	77.50
52	3	7,990	3,920	5,078	130	971.17	431.80	44		53.56	485.81
53	3	6,700	3,960	6,305	159	806.38	530.95	66		69.22	206.21
54	3	7,370	3,430	6,409	187	891.95	543.88	61		67.00	281.07
55	5	12,170	7,710	9,901	128	1,501.22	836.59	56		114.35	550.28
56	1	2,350	970	1,764	182	283.62	147.04	52		19.66	116.92
57	0	--	--	--	--	--	--	--		--	--
58	1	3,150	1,740	2,003	115	386.43	168.38	44		25.81	192.24
59	1	3,730	1,630	2,805	172	439.47	239.84	55		25.41	174.22
60	1	3,790	3,150	4,132	131	446.61	350.36	78		30.62	65.63
61	0	--	--	--	--	--	--	--		--	--
62	1	3,250	2,030	2,671	132	389.75	225.06	58		34.40	130.29
Total or average	223	277,630	175,920	263,581	150	35,571.06	22,218.38	62		2,851.05	10,501.63

^{1/} As scaled by Bureau of Land Management scaler by east-side log scaling rules, Scribner Decimal C log rule.

^{2/} Lumber tally volume as percentage of net scale volume.

^{3/} Lumber cubic volume as percentage of log cubic volume.

TABLE 11.--Log scale, lumber tally, and cubic volume by scaling diameter for No. 2 Sawmill woods-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Log scale ^{1/}		Lumber tally		Cubic volume				
		Gross	Net	Volume	Recovery ratio ^{2/}	Log	Lumber	Lumber recovery ratio ^{3/}	Sawdust	Residue
		Board feet		Percent		Cubic feet		Percent	Cubic feet	
14	1	1,600	1,100	178	16	39.52	14.82	38	2.41	22.29
15	0	--	--	--	--	--	--	--	--	--
16	0	--	--	--	--	--	--	--	--	--
17	0	--	--	--	--	--	--	--	--	--
18	0	--	--	--	--	--	--	--	--	--
19	1	600	210	878	418	101.30	74.02	73	7.80	19.48
20	0	--	--	--	--	--	--	--	--	--
21	0	--	--	--	--	--	--	--	--	--
22	0	--	--	--	--	--	--	--	--	--
23	1	1,150	900	1,322	147	156.55	110.45	71	14.01	32.09
24	0	--	--	--	--	--	--	--	--	--
25	2	2,530	1,400	3,248	232	394.02	273.21	69	39.18	81.63
26	1	1,030	440	700	159	142.70	59.48	42	6.95	76.27
27	0	--	--	--	--	--	--	--	--	--
28	1	1,460	1,250	1,833	147	231.91	152.71	66	23.43	55.77
29	0	--	--	--	--	--	--	--	--	--
30	1	2,090	1,400	2,811	201	313.37	238.16	76	27.68	47.53
31	0	--	--	--	--	--	--	--	--	--
32	2	2,070	1,010	2,343	232	277.74	195.54	70	24.97	57.23
33	1	1,960	980	1,820	186	299.83	153.22	51	23.84	122.77
34	2	4,740	4,290	6,021	140	696.27	504.21	72	71.27	120.79
35	0	--	--	--	--	--	--	--	--	--
36	2	4,600	2,020	6,225	308	807.00	526.54	65	68.13	212.33
37	0	--	--	--	--	--	--	--	--	--
38	2	6,260	4,140	6,828	165	1,026.48	579.80	56	68.55	378.13
39	1	3,590	2,110	4,616	219	596.99	387.94	65	57.74	151.31
40	3	9,170	5,260	10,826	206	1,368.78	913.20	67	114.55	341.03
41	0	--	--	--	--	--	--	--	--	--
42	2	5,040	2,070	4,188	202	704.97	351.20	50	51.36	302.41
43	1	3,480	1,220	3,936	323	515.38	331.24	64	43.35	140.79
44	2	7,400	2,950	7,530	255	1,084.79	636.63	59	83.03	365.13
45	3	11,210	5,410	12,050	223	1,518.39	1,016.99	67	142.97	358.43
46	2	7,920	3,610	8,022	222	1,162.97	675.83	58	88.94	398.20
47	1	4,140	2,070	4,847	234	603.52	400.60	66	49.28	153.64
48	1	4,320	1,510	3,519	233	614.65	296.14	48	39.77	278.74
49	1	4,490	1,570	4,748	302	739.80	402.11	54	49.71	287.98
50	0	--	--	--	--	--	--	--	--	--
51	0	--	--	--	--	--	--	--	--	--
52	0	--	--	--	--	--	--	--	--	--
53	0	--	--	--	--	--	--	--	--	--
54	1	5,460	2,180	4,001	184	815.36	336.16	41	52.47	426.73
55	0	--	--	--	--	--	--	--	--	--
56	0	--	--	--	--	--	--	--	--	--
57	1	6,090	4,700	6,803	145	941.24	575.42	61	65.02	300.80
Total or average	36	102,400	53,800	109,293	203	15,153.53	9,205.62	61	1,216.41	4,731.50

^{1/} As scaled by Forest Service scaler by west-side log scaling rules, Scribner Decimal C log rule.

^{2/} Lumber tally volume as percentage of net scale volume.

^{3/} Lumber cubic volume as percentage of log cubic volume.

TABLE 12.--Log scale, lumber tally, and cubic volume by scaling diameter for No. 3 Sawmill
woods-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Log scale ^{1/}		Lumber tally		Cubic volume				
		Gross	Net	Volume	Recovery ratio ^{2/}	Log	Lumber	Lumber recovery ratio ^{3/}	Sawdust	Residue
		- - - - Board feet - - - -		- - - - Percent		- - Cubic feet - -		- - Cubic feet - -		
10	2	160	100	366	366	54.04	30.39	56	5.01	18.64
11	5	740	420	1,733	413	287.38	145.82	51	19.12	122.44
12	0	--	--	--	--	--	--	--	--	--
13	4	500	380	702	185	123.67	59.32	48	7.09	57.26
14	3	810	490	1,370	280	225.19	115.60	51	12.40	97.19
15	3	680	350	794	227	134.57	66.32	49	9.79	58.46
16	2	560	330	655	198	120.50	54.57	45	8.27	57.66
17	2	1,250	740	1,782	241	273.25	149.91	55	23.34	100.00
18	6	1,920	1,190	2,494	210	387.67	211.06	54	26.69	149.92
19	3	1,200	780	1,976	253	240.98	166.43	69	17.19	57.36
20	3	1,350	690	1,734	251	253.67	145.88	58	21.02	86.77
21	2	1,790	1,190	2,841	239	368.60	238.59	65	31.24	98.77
22	4	3,300	2,320	4,787	206	653.92	402.93	62	47.49	203.50
23	2	1,850	850	3,040	358	388.48	253.71	65	35.41	99.36
24	3	3,020	2,450	4,488	183	512.25	377.90	74	46.32	88.03
25	1	1,380	1,050	1,762	168	249.66	148.13	59	20.30	81.23
26	2	2,360	980	3,247	331	399.13	274.22	69	29.39	95.52
27	0	--	--	--	--	--	--	--	--	--
28	2	2,880	1,370	3,369	246	424.93	280.92	66	42.41	101.60
29	2	2,550	1,210	2,928	242	382.57	245.88	64	37.99	98.70
30	1	1,640	600	1,992	332	319.69	166.37	52	25.89	127.43
31	3	5,000	2,490	7,210	290	792.12	608.26	77	65.54	118.32
32	0	--	--	--	--	--	--	--	--	--
33	3	6,410	3,860	9,073	235	1,101.95	764.42	69	93.10	244.43
34	2	4,000	1,590	4,809	302	679.15	407.59	60	48.03	223.53
35	5	11,030	5,490	15,093	275	1,849.04	1,278.22	69	126.39	444.43
36	2	4,600	2,230	6,654	298	746.78	559.96	75	66.94	119.88
37	0	--	--	--	--	--	--	--	--	--
38	4	11,270	4,780	14,294	299	1,875.91	1,198.26	64	164.51	513.14
39	0	--	--	--	--	--	--	--	--	--
40	1	3,000	1,040	2,832	272	423.53	243.31	57	28.19	152.03
41	0	--	--	--	--	--	--	--	--	--
42	0	--	--	--	--	--	--	--	--	--
43	0	--	--	--	--	--	--	--	--	--
44	2	8,080	3,910	7,886	202	1,163.14	664.14	57	84.78	414.72
45	1	3,980	1,590	3,568	224	645.44	304.29	47	33.37	307.78
46	2	6,140	3,550	4,557	128	908.29	383.76	42	55.68	468.85
47	0	--	--	--	--	--	--	--	--	--
48	1	4,320	2,160	5,329	247	638.79	446.65	70	56.49	135.65
49	2	9,190	5,870	8,481	144	1,243.19	712.79	57	97.70	432.70
50	0	--	--	--	--	--	--	--	--	--
51	1	4,870	1,700	4,818	283	648.90	411.83	63	42.87	194.20
Total or average	81	111,830	57,750	136,664	237	18,516.88	11,517.43	62	1,429.95	5,569.50

^{1/} As scaled by Forest Service scaler by west-side log scaling rules, Scribner Decimal C log rule.

^{2/} Lumber tally volume as percentage of net scale volume.

^{3/} Lumber cubic volume as percentage of log cubic volume.

TABLE 13.--Log scale, lumber tally, and cubic volume by scaling diameter for all log grades of woods-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Log scale ^{1/}		Lumber tally		Cubic volume				
		Gross	Net	Volume	Recovery ratio ^{2/}	Log	Lumber	Lumber recovery ratio ^{3/}	Sawdust	Residue
		Board feet		Percent		Cubic feet		Percent		Cubic feet
10	2	160	100	366	366	54.04	30.39	56	5.01	18.64
11	5	740	420	1,733	413	287.38	145.82	51	19.12	122.44
12	0	--	--	--	--	--	--	--	--	--
13	4	500	380	702	185	123.67	59.32	48	7.09	57.26
14	4	2,410	1,590	1,548	97	264.71	130.42	49	14.81	119.48
15	3	680	350	794	227	134.57	66.32	49	9.79	58.46
16	2	560	330	655	198	120.50	54.57	45	8.27	57.66
17	2	1,250	740	1,782	241	273.25	149.91	55	23.34	100.00
18	6	1,920	1,190	2,494	210	387.67	211.06	54	26.69	149.92
19	4	1,800	990	2,854	288	342.28	240.45	70	24.99	76.84
20	3	1,350	690	1,734	251	253.67	145.88	58	21.02	86.77
21	2	1,790	1,190	2,841	239	368.60	238.59	65	31.24	98.77
22	4	3,300	2,320	4,787	206	653.92	402.93	62	47.49	203.50
23	3	3,000	1,750	4,362	249	545.03	364.16	67	49.42	131.45
24	3	3,020	2,450	4,488	183	512.25	377.90	74	46.32	88.03
25	3	3,910	2,450	5,010	204	643.68	421.34	65	59.48	162.86
26	3	3,390	1,420	3,947	278	541.83	333.70	62	36.34	171.79
27	0	--	--	--	--	--	--	--	--	--
28	3	4,340	2,620	5,202	199	656.84	433.63	66	65.84	157.37
29	2	2,550	1,210	2,928	242	382.57	245.88	64	37.99	98.70
30	2	3,730	2,000	4,803	240	633.06	404.53	64	53.57	174.96
31	3	5,000	2,490	7,210	290	792.12	608.26	77	65.54	118.32
32	2	2,070	1,010	2,343	232	277.74	195.54	70	24.97	57.23
33	4	8,370	4,840	10,893	225	1,401.78	917.64	65	116.94	367.20
34	4	8,740	5,880	10,830	184	1,375.42	911.80	66	119.30	344.32
35	5	11,030	5,490	15,093	275	1,849.04	1,278.22	69	126.39	444.43
36	4	9,200	4,250	12,879	303	1,553.78	1,086.50	70	135.07	332.21
37	0	--	--	--	--	--	--	--	--	--
38	6	17,530	8,920	21,122	237	2,902.39	1,778.06	61	233.06	891.27
39	1	3,590	2,110	4,616	219	596.99	387.94	65	57.74	151.31
40	4	12,170	6,300	13,658	217	1,792.31	1,156.51	65	142.74	493.06
41	0	--	--	--	--	--	--	--	--	--
42	2	5,040	2,070	4,188	202	704.97	351.20	50	51.36	302.41
43	1	3,480	1,220	3,936	323	515.38	331.24	64	43.35	140.79
44	4	15,480	6,860	15,416	225	2,248.43	1,300.77	58	167.81	779.85
45	4	15,190	7,000	15,618	223	2,163.83	1,321.28	61	176.34	666.21
46	4	14,060	7,160	12,579	176	2,071.26	1,059.59	51	144.62	867.05
47	1	4,140	2,070	4,847	234	603.52	400.60	66	49.28	153.64
48	2	8,640	3,670	8,848	241	1,253.44	742.79	59	96.26	414.39
49	3	13,680	7,440	13,229	178	1,982.99	1,114.90	56	147.41	720.68
50	0	--	--	--	--	--	--	--	--	--
51	1	4,870	1,700	4,818	283	648.90	411.83	63	42.87	194.20
52	0	--	--	--	--	--	--	--	--	--
53	0	--	--	--	--	--	--	--	--	--
54	1	5,460	2,180	4,001	184	815.36	336.16	41	52.47	426.73
55	0	--	--	--	--	--	--	--	--	--
56	0	--	--	--	--	--	--	--	--	--
57	1	6,090	4,700	6,803	145	941.24	575.42	61	65.02	300.80
Total or average	117	214,230	111,550	245,957	220	33,670.41	20,723.05	62	2,646.36	10,301.00

^{1/} As scaled by Forest Service scaler by west-side log scaling rules, Scribner Decimal C log rule.

^{2/} Lumber tally volume as percentage of net scale volume.

^{3/} Lumber cubic volume as percentage of log cubic volume.

TABLE 14.--Lumber grade yields expressed as a percent of lumber tally volume by scaling diameter, No. 2 Sawmill
sawn-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Lumber tally volume	Lumber grade							
			B and Better Select	C Select	D Select	Select Structural	No. 1 and Construction	No. 2 and Standard	No. 3 and Utility	Economy
Board feet										
13	1	53	0	0	--	--	45.28	54.72	--	--
14	1	173	0	0	12.14	--	35.84	15.61	29.48	6.94
15	1	286	--	--	--	--	5.59	4.55	59.09	30.77
16	0	--	--	--	--	--	--	--	--	--
17	0	--	--	--	--	--	--	--	--	--
18	0	--	--	--	--	--	--	--	--	--
19	1	344	--	--	--	--	19.19	65.99	14.83	--
20	0	--	--	--	--	--	--	--	--	--
21	1	534	--	--	--	--	--	--	34.27	65.73
22	0	--	--	--	--	--	--	--	--	--
23	1	635	--	.47	1.89	10.39	32.44	25.04	24.88	4.88
24	0	--	--	--	--	--	--	--	--	--
25	2	925	--	23.14	--	3.14	6.81	15.89	17.84	33.19
26	0	--	--	--	--	--	--	--	--	--
27	0	--	--	--	--	--	--	--	--	--
28	3	2,564	--	4.68	--	12.52	10.92	35.57	15.56	20.75
29	2	1,737	--	16.00	.92	15.20	21.82	15.77	15.43	14.85
30	0	--	--	--	--	--	--	--	--	--
31	1	976	--	24.28	--	33.91	9.73	5.12	9.84	17.11
32	3	2,681	--	6.60	4.89	3.28	9.62	15.93	35.84	23.83
33	1	571	--	23.47	--	--	--	5.60	2.10	68.83
34	1	1,328	--	4.97	2.18	13.78	9.94	43.30	24.55	1.28
35	0	--	--	--	--	--	--	--	--	--
36	3	4,127	--	17.32	.70	8.14	14.30	5.62	19.12	34.80
37	0	--	--	--	--	--	--	--	--	--
38	2	3,373	--	23.27	4.24	14.23	5.60	11.24	19.63	21.79
39	2	3,282	--	3.81	.21	.79	1.77	9.66	64.93	18.83
40	1	882	--	12.24	.91	--	1.47	1.47	24.60	59.30
41	4	6,328	--	6.13	.49	.21	5.89	6.15	30.78	50.35
42	1	1,396	--	58.88	--	--	3.15	2.01	14.47	21.49
43	3	5,146	.68	6.18	1.42	--	.47	.70	14.34	76.21
44	2	3,788	--	36.67	5.49	1.24	1.16	4.96	7.95	42.53
45	5	11,291	--	2.41	1.20	1.75	4.01	7.86	40.66	42.10
46	2	2,537	--	40.20	2.01	2.56	4.10	5.36	17.26	28.50
47	2	5,302	--	3.23	4.13	3.19	6.24	6.94	38.55	37.72
48	2	3,886	--	23.34	1.11	.08	.82	.75	21.90	52.01
49	0	--	--	--	--	--	--	--	--	--
50	1	1,158	--	7.77	1.81	--	--	6.74	29.88	53.80
51	1	3,376	--	31.69	4.00	--	.09	--	20.38	43.84
52	1	1,113	--	10.24	.45	2.52	3.86	12.13	19.14	51.66
53	1	1,857	--	6.14	2.75	2.53	.92	2.21	16.69	68.77
54	2	5,028	--	10.86	7.46	.36	--	--	30.09	51.23
55	4	7,903	--	9.74	2.13	1.37	8.50	15.56	21.98	40.72
56	0	--	--	--	--	--	--	--	--	--
57	0	--	--	--	--	--	--	--	--	--
58	1	2,003	--	22.02	7.24	.80	5.59	7.19	27.86	29.31
59	1	2,805	--	1.89	.18	--	--	--	22.25	75.69
60	1	4,132	--	2.59	.27	--	3.90	18.83	57.50	16.92
61	0	--	--	--	--	--	--	--	--	--
62	1	2,671	--	13.44	3.44	4.68	10.63	.19	17.52	50.09
Total or average	62	96,191	.04	12.38	2.25	3.08	5.33	8.61	27.64	40.67

TABLE 15.--Lumber grade yields expressed as a percent of lumber tally volume by scaling diameter, No. 3 Sawmill sawn-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Lumber tally volume	Lumber grade							
			B and Better Select	C Select	D Select	Select Structural	No. 1 and Construction	No. 2 and Standard	No. 3 and Utility	Economy
Board feet										
10	2	423	--	0.71	--	--	--	18.68	34.28	46.34
11	3	342	--	--	--	6.14	36.84	30.70	20.18	6.14
12	2	395	--	--	--	--	22.78	22.78	38.23	16.20
13	1	84	--	--	--	--	7.14	--	20.24	72.62
14	2	278	--	--	--	3.60	2.88	11.51	82.01	--
15	4	973	--	--	--	--	.82	17.99	67.32	13.87
16	1	320	--	7.19	--	13.44	7.19	68.75	--	3.44
17	4	1,301	--	--	1.00	3.31	17.60	26.06	14.68	37.36
18	4	628	--	--	.80	--	22.93	8.12	32.96	35.19
19	7	2,144	--	--	--	.14	6.58	26.40	22.15	44.73
20	3	722	--	--	--	--	--	23.13	27.42	49.45
21	3	1,399	--	--	--	.21	2.00	32.59	34.10	31.09
22	8	3,714	--	.13	--	1.45	7.11	18.66	41.44	31.21
23	3	1,688	--	.24	--	--	--	12.03	38.74	48.99
24	8	5,294	--	.15	--	.91	3.25	20.57	34.04	41.08
25	4	1,773	--	--	--	3.16	10.04	13.87	39.93	32.99
26	6	4,237	--	.17	.12	--	7.67	18.29	35.69	38.07
27	3	1,782	--	3.48	--	5.16	5.44	26.21	31.87	27.83
28	5	4,039	--	3.00	--	1.78	8.05	8.52	40.63	38.03
29	4	4,116	--	--	--	--	3.11	17.30	48.59	31.00
30	4	3,653	--	1.51	--	3.15	4.79	16.45	53.30	20.80
31	8	8,492	--	1.78	.16	.51	1.97	19.27	43.99	32.32
32	8	9,320	--	1.74	.43	.55	3.76	27.14	36.76	29.64
33	2	2,810	--	1.60	--	.25	1.57	12.88	61.67	22.03
34	4	4,237	--	3.45	--	2.36	9.25	14.26	39.51	31.18
35	0	--	--	--	--	--	--	--	--	--
36	5	6,684	0.06	3.05	.91	.48	4.80	7.97	23.85	58.87
37	9	14,498	--	1.55	.13	.15	2.91	24.08	54.51	16.67
38	3	5,118	--	.39	.43	--	9.55	24.97	34.29	30.36
39	3	4,802	--	4.08	--	.75	1.79	14.04	30.65	48.69
40	2	2,547	--	6.20	.31	.24	8.36	8.32	14.29	62.27
41	5	9,008	--	2.43	1.10	.40	.81	13.65	44.75	36.86
42	3	6,217	--	7.11	1.40	2.22	6.58	11.95	45.49	25.25
43	2	2,573	--	.47	.27	1.36	5.09	8.39	33.27	51.15
44	4	6,007	--	2.01	.22	.32	9.74	18.43	33.91	35.38
45	2	4,410	--	--	.45	2.00	3.31	5.51	40.93	47.80
46	7	16,391	--	4.29	.84	1.64	1.31	5.95	37.09	48.88
47	3	5,807	--	3.69	.67	1.08	1.79	9.92	45.70	37.14
48	1	1,962	--	--	--	--	2.60	24.62	30.33	42.46
49	1	1,445	--	3.39	--	--	--	3.32	45.26	48.03
50	1	2,201	--	1.23	.23	.41	.95	.14	44.48	52.57
51	0	--	--	--	--	--	--	--	--	--
52	2	3,965	--	1.51	.50	--	1.51	3.40	24.21	68.85
53	2	4,448	1.69	8.09	.90	--	.74	1.80	17.83	68.95
54	1	1,381	--	--	--	--	--	--	2.32	97.68
55	1	1,998	--	9.11	--	.55	5.01	5.36	36.94	43.04
56	1	1,764	--	--	--	--	--	--	11.17	88.83
Total or average	161	167,390	.05	2.38	.39	.91	4.11	14.74	38.28	39.14

TABLE 16.--Lumber grade yields expressed as a percent of lumber tally volume by scaling diameter, No. 2 Sawmill woods-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Lumber tally volume	Lumber grade							
			B and Better Select	C Select	D Select	Select Structural	No. 1 and Construction	No. 2 and Standard	No. 3 and Utility	Economy
Board feet										
14	1	178	0	0	0	0	47.75	37.64	11.80	2.81
15	0	--	--	--	--	--	--	--	--	--
16	0	--	--	--	--	--	--	--	--	--
17	0	--	--	--	--	--	--	--	--	--
18	0	--	--	--	--	--	--	--	--	--
19	1	878	0	0	0	0	7.52	25.85	26.65	39.98
20	0	--	--	--	--	--	--	--	--	--
21	0	--	--	--	--	--	--	--	--	--
22	0	--	--	--	--	--	--	--	--	--
23	1	1,322	0	.61	.91	29.27	21.48	25.34	18.61	3.78
24	0	--	--	--	--	--	--	--	--	--
25	2	3,248	0	11.24	.09	.89	12.65	12.01	24.29	38.82
26	1	700	0	1.57	0	1.57	3.86	6.71	74.57	11.71
27	0	--	--	--	--	--	--	--	--	--
28	1	1,833	0	2.56	0	4.80	22.09	50.46	18.11	1.96
29	0	--	--	--	--	--	--	--	--	--
30	1	2,811	0	0	0	0	0	0	.82	99.18
31	0	--	--	--	--	--	--	--	--	--
32	2	2,343	0	5.25	1.02	2.18	5.46	15.32	43.96	26.80
33	1	1,820	0	3.57	0	1.76	17.03	27.53	29.73	20.38
34	2	6,021	0	19.60	1.99	7.14	14.50	17.57	19.50	19.70
35	0	--	--	--	--	--	--	--	--	--
36	2	6,225	.06	8.10	1.51	0	3.28	9.65	30.09	47.31
37	0	--	--	--	--	--	--	--	--	--
38	2	6,828	0	13.62	0	.34	1.07	15.79	29.04	40.14
39	1	4,616	0	19.43	3.90	8.82	1.19	8.08	14.30	44.28
40	3	10,826	0	7.19	1.82	.82	2.07	6.16	45.39	36.55
41	0	--	--	--	--	--	--	--	--	--
42	2	4,188	.33	3.99	3.03	2.39	6.64	7.69	17.88	58.05
43	1	3,936	0	2.08	0	1.63	.76	21.47	38.82	35.24
44	2	7,530	0	.41	1.54	2.35	7.89	6.56	40.78	40.46
45	3	12,050	0	25.19	3.10	2.31	3.27	7.93	19.76	38.46
46	2	8,022	0	1.98	1.13	.59	.85	8.36	23.97	63.11
47	1	4,847	0	2.95	1.57	5.78	5.57	3.80	21.39	58.94
48	1	3,519	0	.68	.28	0	0	1.99	8.27	88.78
49	1	4,748	0	25.13	3.58	0	.06	0	19.59	51.64
50	0	--	--	--	--	--	--	--	--	--
51	0	--	--	--	--	--	--	--	--	--
52	0	--	--	--	--	--	--	--	--	--
53	0	--	--	--	--	--	--	--	--	--
54	1	4,001	0	15.57	3.62	.67	5.30	6.27	32.39	36.17
55	0	--	--	--	--	--	--	--	--	--
56	0	--	--	--	--	--	--	--	--	--
57	1	6,803	0	6.85	1.51	1.84	6.54	11.51	41.81	29.94
Total or average	36	109,293	.02	9.91	1.68	2.42	4.98	10.25	27.81	42.93

TABLE 17.--Lumber grade yields expressed as a percent of lumber tally volume by scaling diameter, No. 3 Sawmill woods-length Coast Douglas-fir logs

Log scaling diameter (inches)	Number of logs	Lumber tally volume	Lumber grade							
			B and Better Select	C Select	D Select	Select Structural	No. 1 and Construction	No. 2 and Standard	No. 3 and Utility	Economy
Board feet										
10	2	366	0	0.82	0	0	7.38	2.19	65.30	36.69
11	5	1,733	0	1.33	0	3.69	12.93	35.83	22.33	52.84
12	0	--	--	--	--	--	--	--	--	--
13	4	702	0	0	0	7.55	15.67	25.93	41.60	57.83
14	3	1,370	0	.29	0	0	.58	13.65	52.92	39.26
15	3	794	0	0	2.64	0	10.71	8.19	57.30	41.18
16	2	655	0	0	0	0	14.66	3.66	3.05	28.79
17	2	1,782	0	.28	.73	0	.84	7.24	29.91	27.71
18	6	2,494	0	0	.20	.20	2.69	8.62	33.76	31.73
19	3	1,976	0	0	0	1.37	14.98	51.97	22.67	62.23
20	3	1,734	0	.40	.29	0	8.48	16.44	29.41	36.17
21	2	2,841	0	0	0	0	3.06	17.28	56.67	40.53
22	4	4,787	0	2.17	.23	2.95	3.43	23.96	49.13	48.35
23	2	3,040	0	0	0	0	0	11.94	56.51	34.61
24	3	4,488	0	1.16	0	4.95	13.57	26.76	43.83	54.54
25	1	1,762	0	0	0	0	.23	5.56	36.32	28.37
26	2	3,247	0	1.97	0	0	.99	36.40	30.64	49.15
27	0	--	--	--	--	--	--	--	--	--
28	2	3,369	0	2.91	0	.50	3.27	21.04	47.61	41.26
29	2	2,928	0	1.88	0	.58	7.10	14.52	51.33	40.31
30	1	1,992	0	2.31	.55	0	2.11	9.74	47.24	33.76
31	3	7,210	0	1.11	.40	2.68	8.52	26.53	34.94	49.50
32	0	--	--	--	--	--	--	--	--	--
33	3	9,073	0	1.83	.23	.41	1.23	9.89	53.79	39.42
34	2	4,809	0	5.05	.31	2.81	10.02	8.73	25.10	45.26
35	5	15,093	0	1.29	.23	.21	2.63	8.92	47.19	38.99
36	2	6,654	0	5.50	.63	.36	2.07	27.97	46.35	52.24
37	0	--	--	--	--	--	--	--	--	--
38	4	14,294	0	2.80	.42	.62	1.47	9.41	42.98	35.83
39	0	--	--	--	--	--	--	--	--	--
40	1	2,832	1.24	13.42	5.90	1.27	.95	5.83	14.37	50.17
41	0	--	--	--	--	--	--	--	--	--
42	0	--	--	--	--	--	--	--	--	--
43	0	--	--	--	--	--	--	--	--	--
44	2	7,886	0	2.32	.16	.60	7.58	12.57	44.34	42.32
45	1	3,568	0	.81	0	0	0	.20	23.68	25.40
46	2	4,557	0	4.15	.70	.22	.99	5.66	28.57	31.46
47	0	--	--	--	--	--	--	--	--	--
48	1	5,329	0	.99	.09	.17	.39	1.20	27.23	27.27
49	2	8,481	0	4.59	.39	0	7.48	15.91	41.16	44.31
50	0	--	--	--	--	--	--	--	--	--
51	1	4,818	0	1.58	.35	0	0	0	18.10	25.65
Total or average	81	136,664	.03	2.35	.39	.85	4.10	14.03	39.95	40.47



Snellgrove, Thomas A., John W. Henley, and Marlin E. Plank
1975. Lumber recovery from large, highly defective, low grade
Douglas-fir. USDA For. Serv. Research Paper PNW-197,
23 p. Pacific Northwest Forest and Range Experiment Station,
Portland, Oregon.

A sample of 51 large diameter, highly defective, low grade
Coast Douglas-fir trees were processed in a western Oregon
sawmill. Lumber grade yields and recovery ratios are presented
for two log-scaling and grading practices. The 51 trees generated
117 woods-length logs and 223 sawn-length logs which, in turn,
produced about 1/4 million board feet of rough-green lumber.
Some key results of this study are compared with an earlier study.

KEYWORDS: Lumber recovery studies, Coast Douglas-fir.

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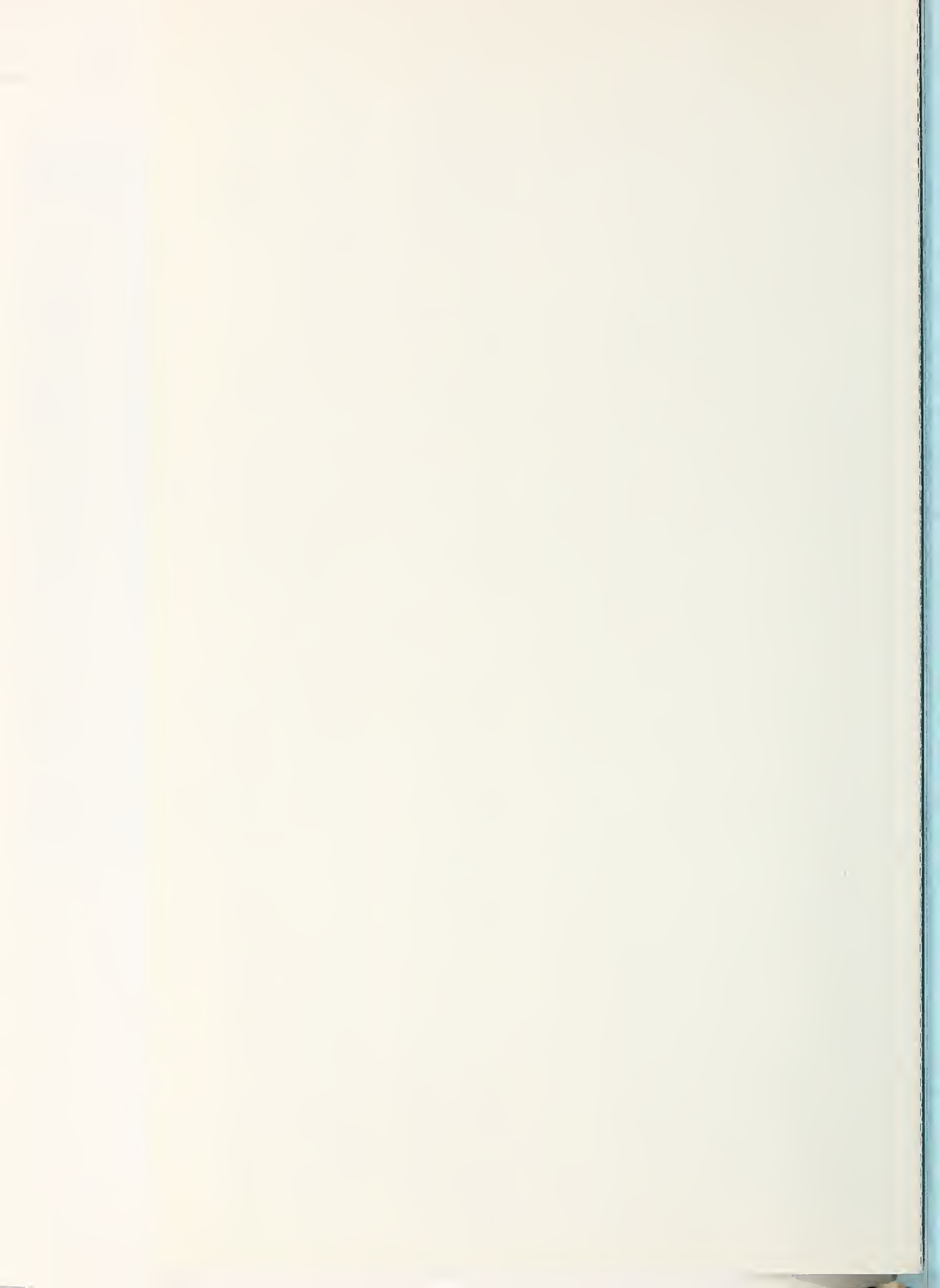
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P.O. Box 3141
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